

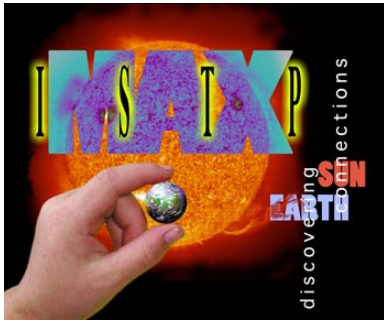


International Solar Terrestrial Physics Program

Fresh Perspectives on the
Complexities of Geospace Dynamics

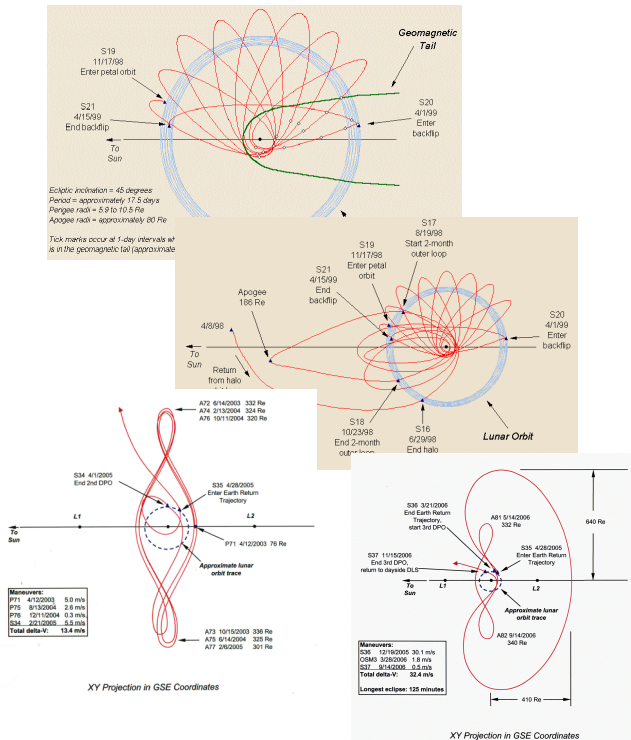


Geotail
Wind
SOHO
Polar
Cluster
Theory & Ground Based

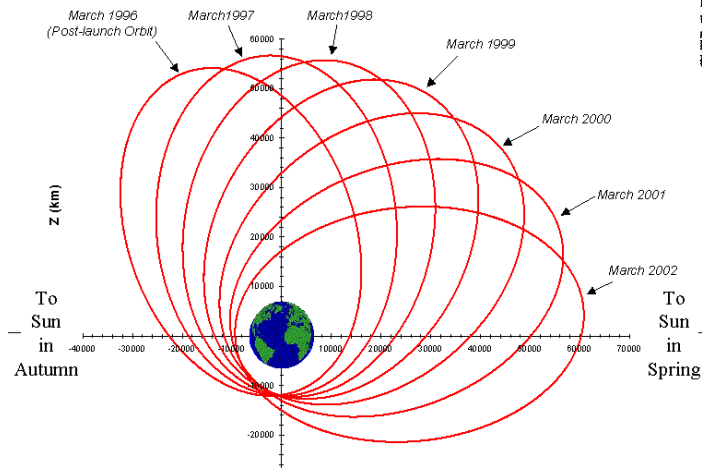


Fresh Perspectives: evolving orbits

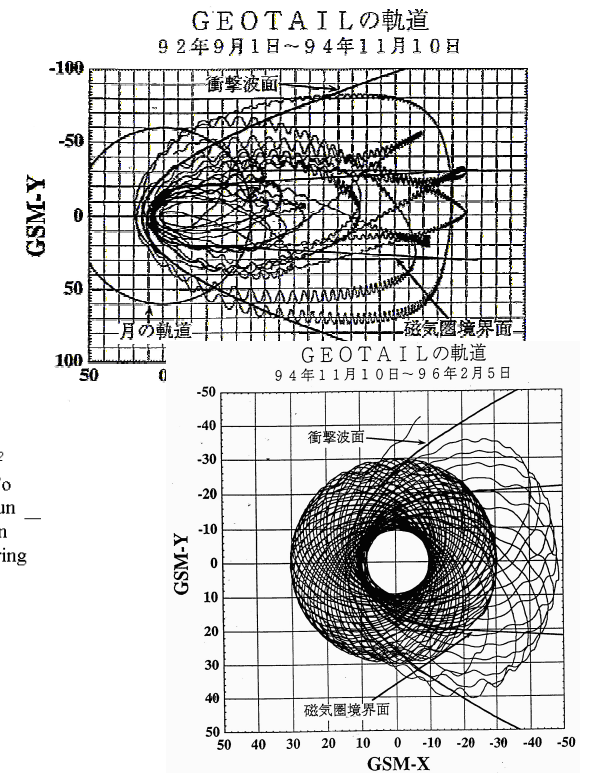
The orbits aren't what they used to be ...



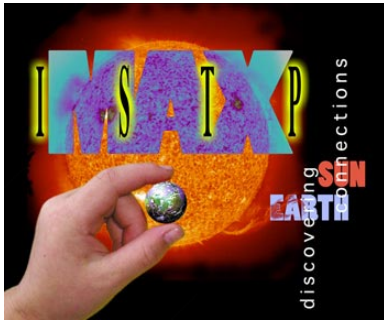
Wind continues its tour of the near earth heliosphere



Polar becomes an equatorial mission

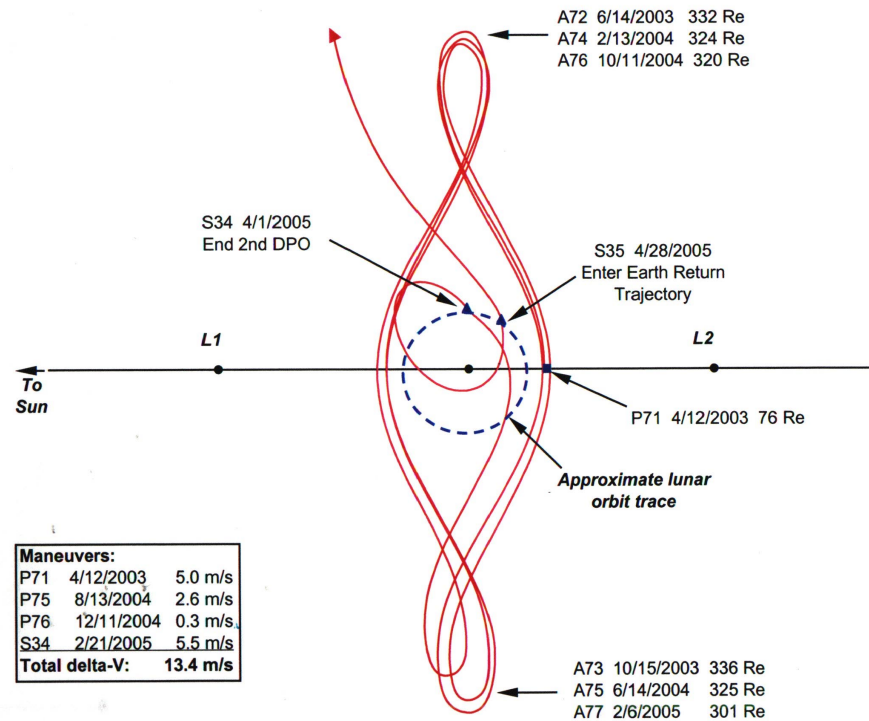


Geotail observes in tail and heliosphere



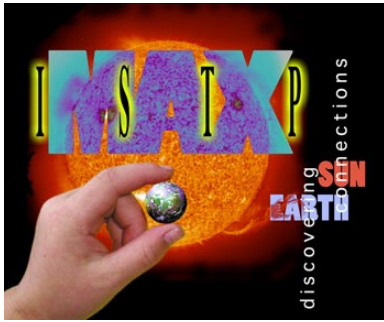
Evolving orbits: Wind

Extension of WIND's 2nd Distant Prograde Orbit (DPO) => Earth Return Trajectory
April 2003 - April 2005



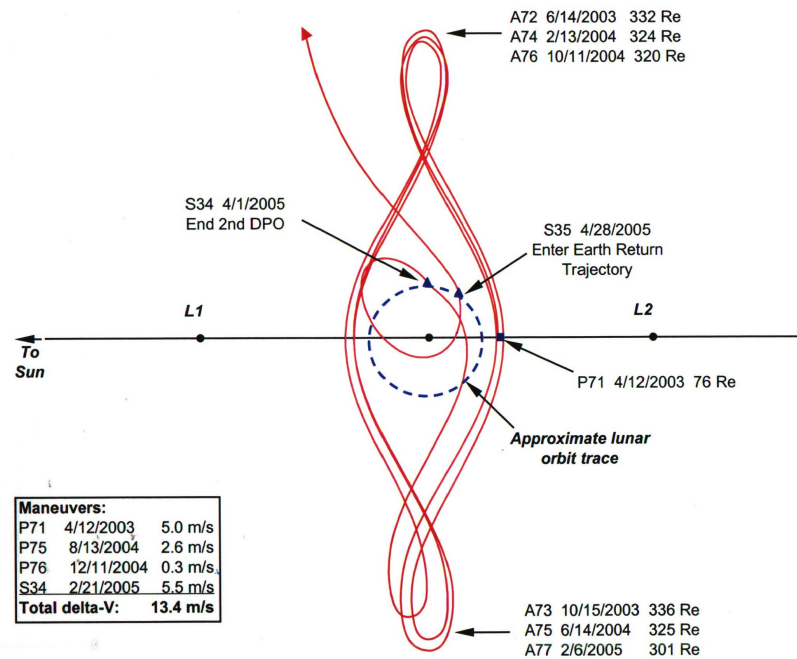
XY Projection in GSE Coordinates

10/19/00
 MOON9E



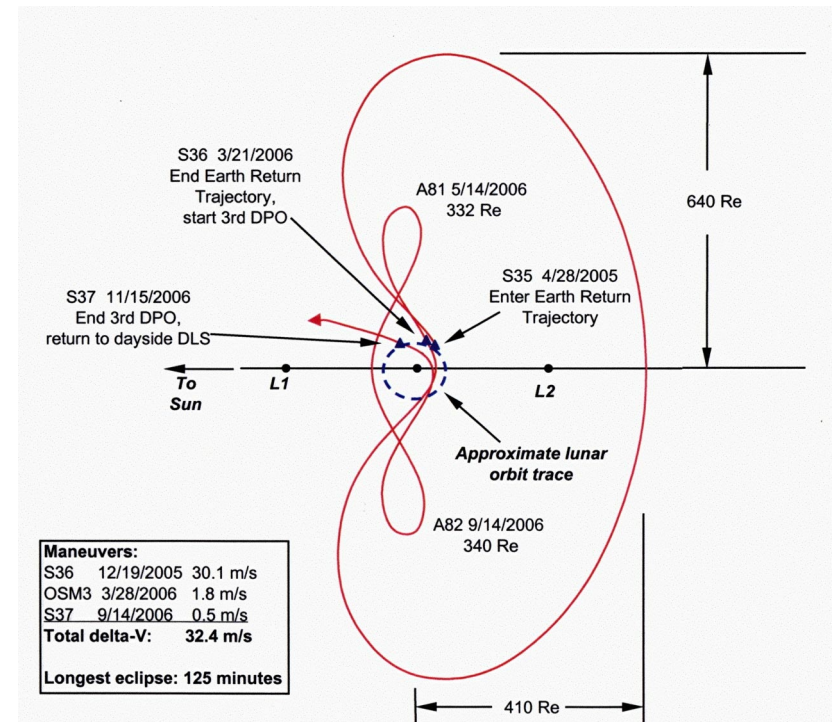
Evolving orbits: Wind

Extension of WIND's 2nd Distant Prograde Orbit (DPO) Earth Return Trajectory April 2003-April 2005

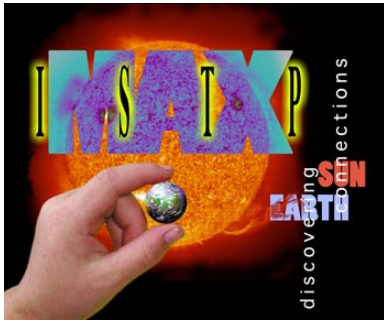


XY Projection in GSE Coordinates

WIND Earth Return Trajectory 3rd Distant Prograde Orbit Dayside DLS April 2005 - November 2006

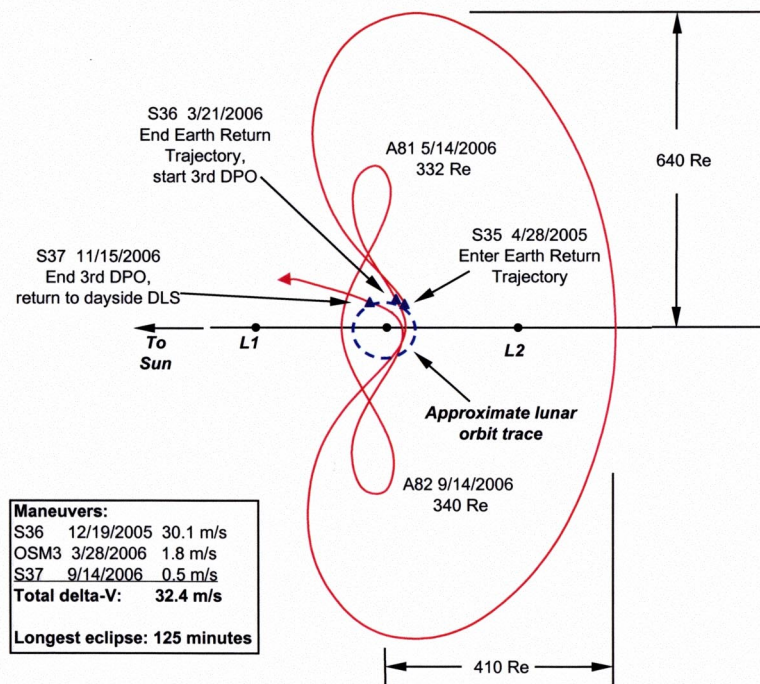


XY Projection in GSE Coordinates



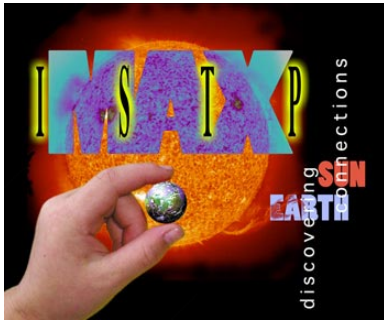
Evolving orbits: Wind

WIND Earth Return Trajectory => 3rd Distant Prograde Orbit => Dayside DLS
April 2005 - November 2006



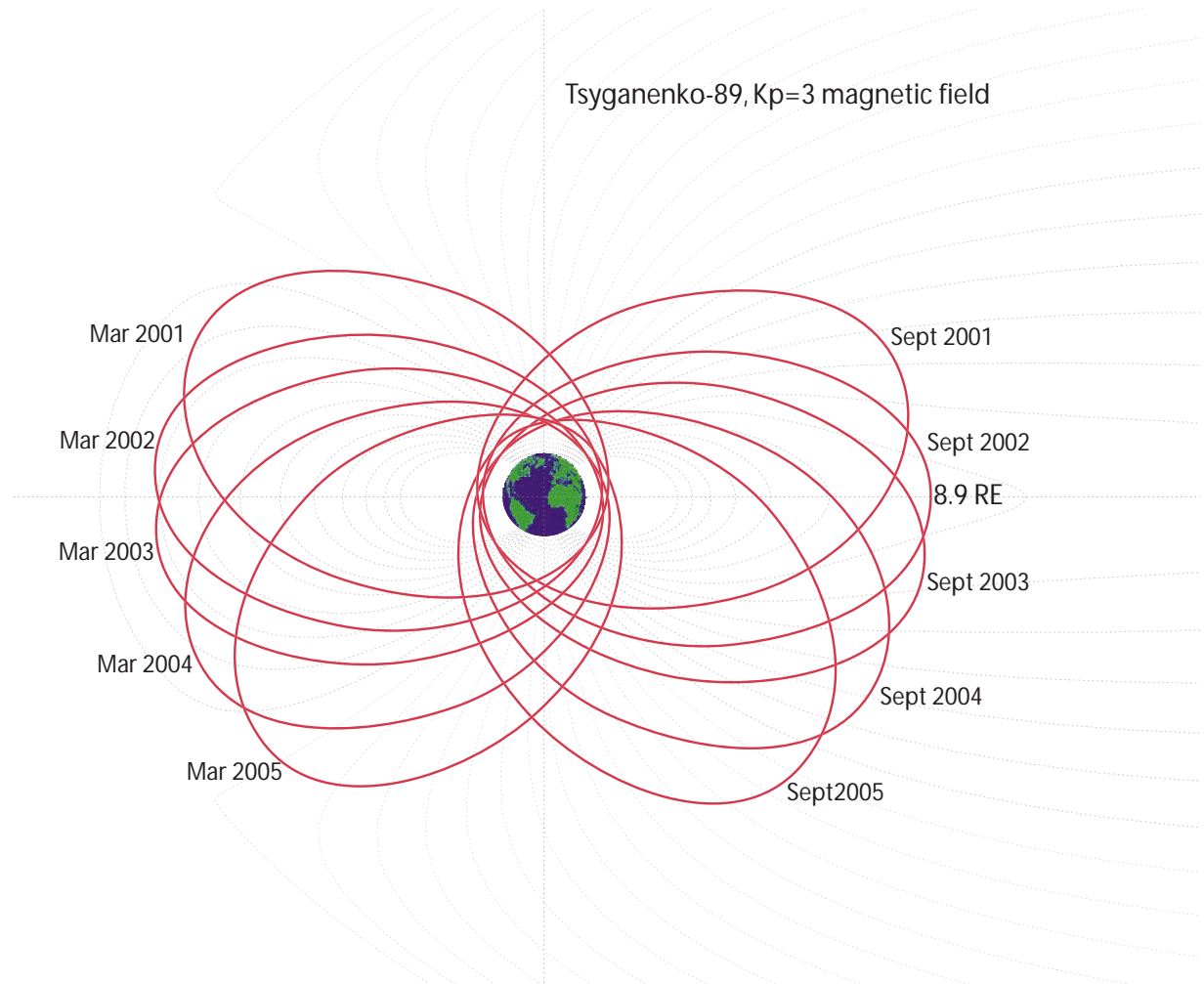
XY Projection in GSE Coordinates

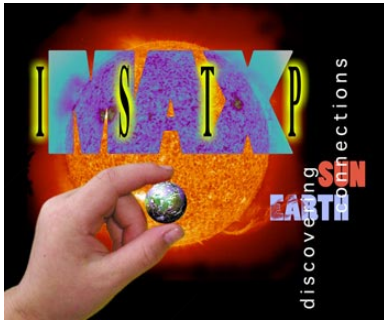
10/19/06
 MOON



Evolving orbits: Polar

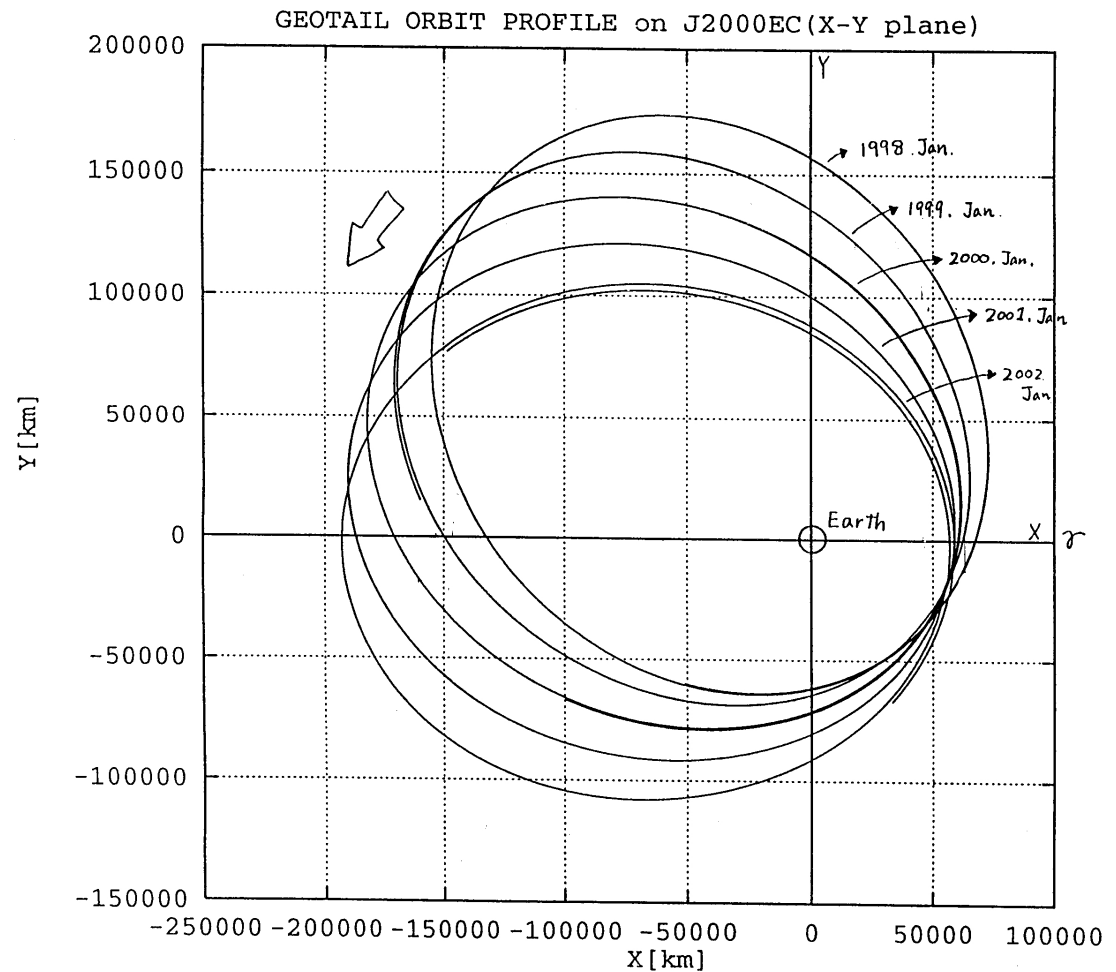
The apogee of Polar has drifted towards the equator and will provide key insight into the nightside (Fall) and dayside (Spring) magnetosphere by observing in those regions for many hours per orbit.

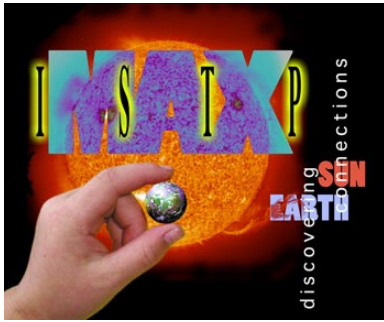




Evolving orbits: Geotail

Geotail has now used up its propellant and the apogee is now drifting slightly as shown by the orbits in successive years in January.

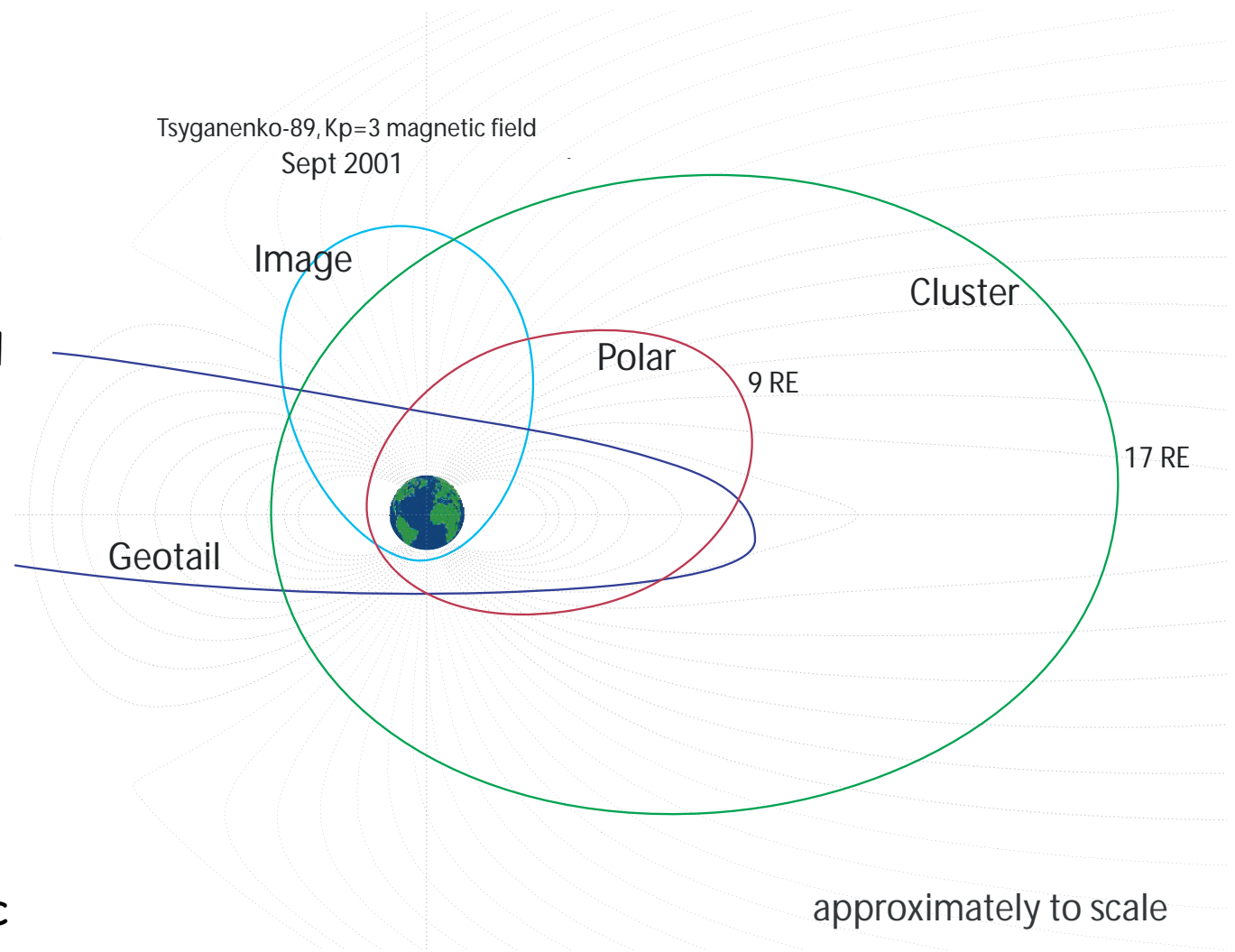


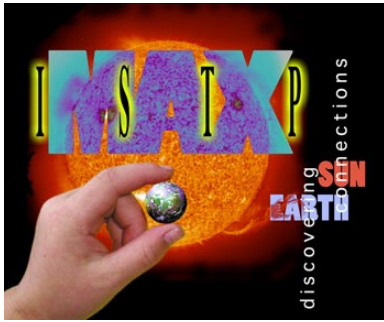


Evolving orbits: Fresh perspectives on the nightside

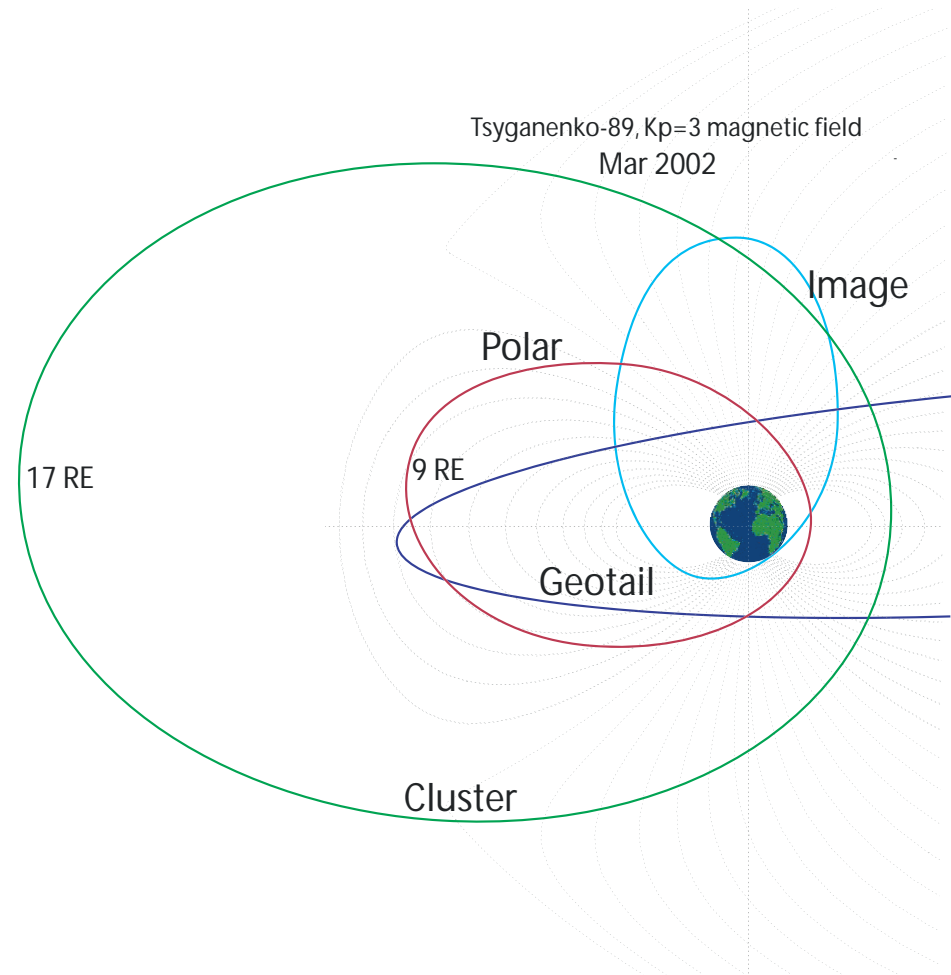
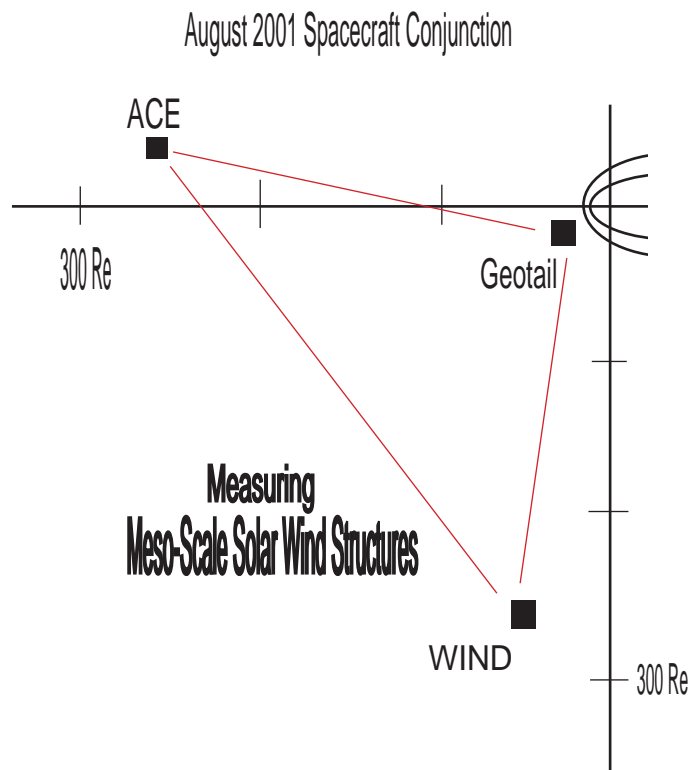
Polar remains at the same local time for several hours providing good probability that another spacecraft will be located near the same sector during substorm periods.

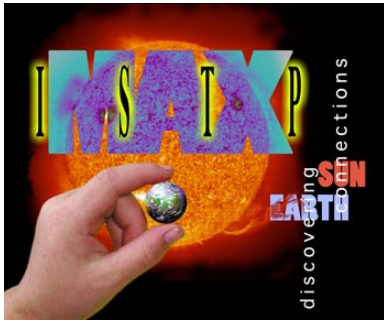
Such conjugate observations allow studies of the radial propagation of substorm disturbances such as particle injections and magnetic field dipolarizations.





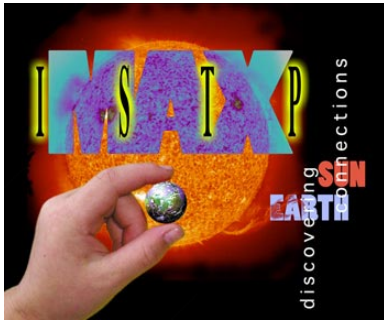
Evolving orbits: Fresh perspectives on the dayside





What we have learned: Selected accomplishments

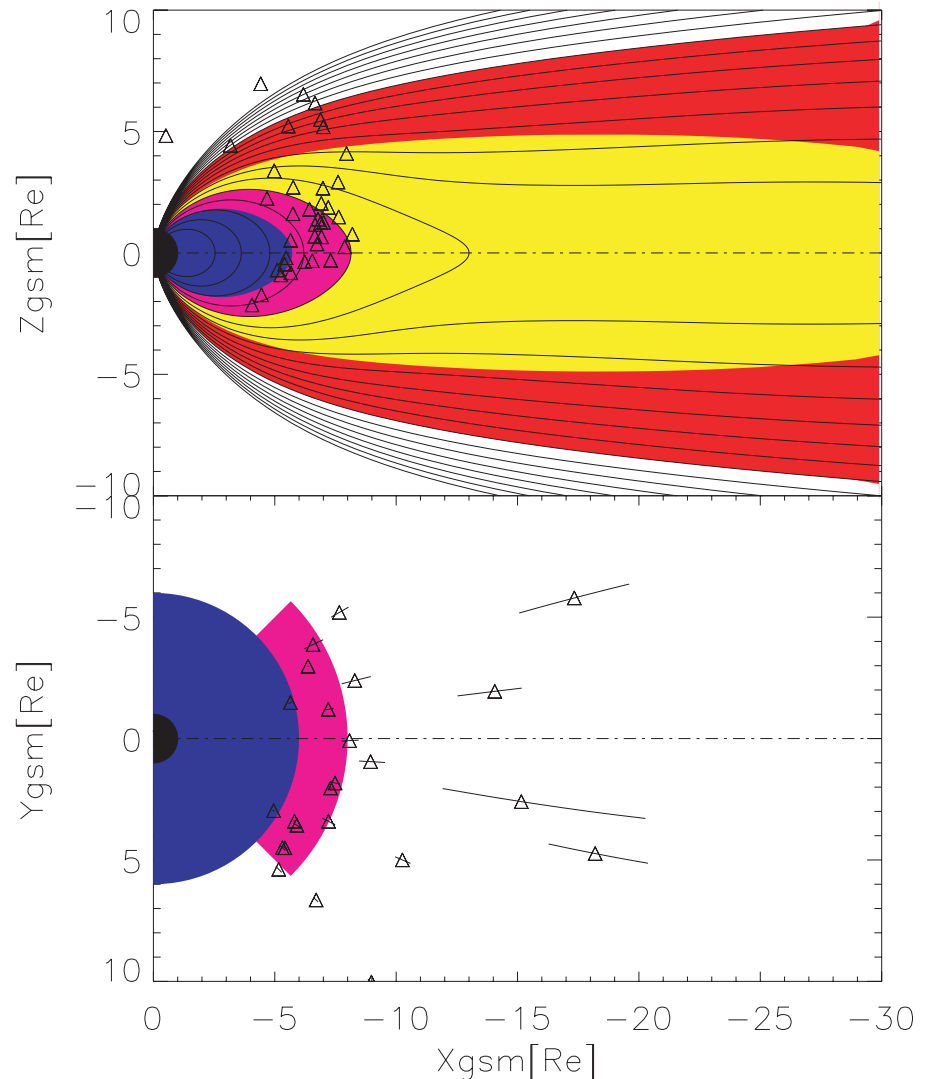
- Observations by WIND/Waves and SOHO/Lasco show that the shock front trajectories of colliding CMEs are altered.
- Direct observations using each of the ISTP spacecraft have extended our knowledge and understanding of collisionless reconnection phenomena.
- First direct measurement of E parallel and the associated acceleration by solitary wave structures.
- Poynting flux measured above the E parallel region at edge of plasma sheet and pointing down the magnetic field with sufficient energy to account for all auroral phenomena
- Placement of the cause of substorm onset (auroral brightening) in the near plasma sheet and observation of plasma braking prior to onset
- Discovery of very high energy ions (MeV) in the cusp.

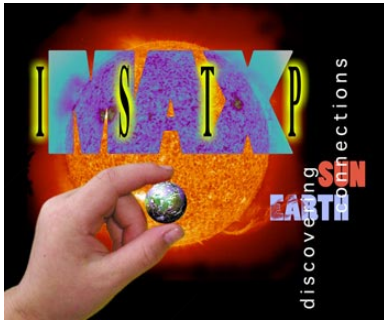


What we will learn that is new:

- Why does significant energy flow to the ionosphere when it does:
Substorms vs Pseudo breakups?
- Where do substorms originate:
8 Re or 25 Re?
- Does the prestorm plasma sheet influence the intensity of the following storm?
- Are flow bursts related to low latitude auroral zone substorms, polar cap boundary auroral intensifications or both?

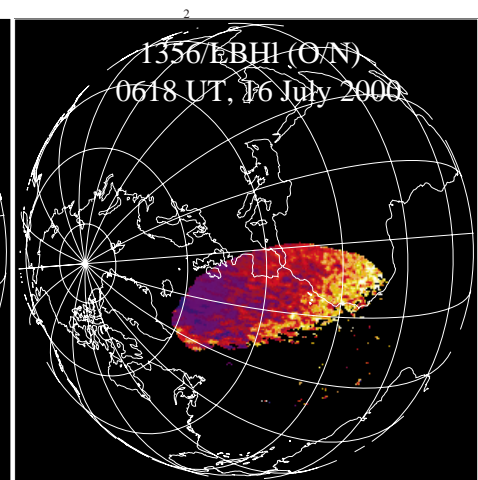
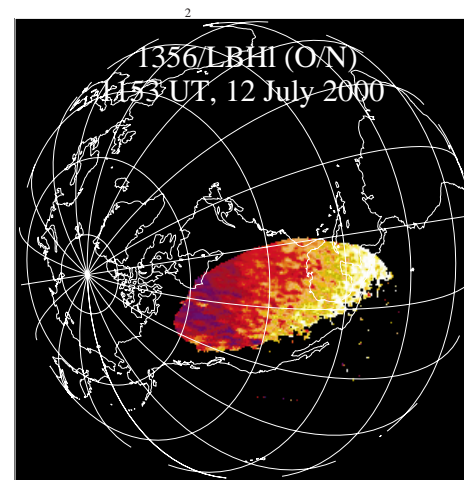
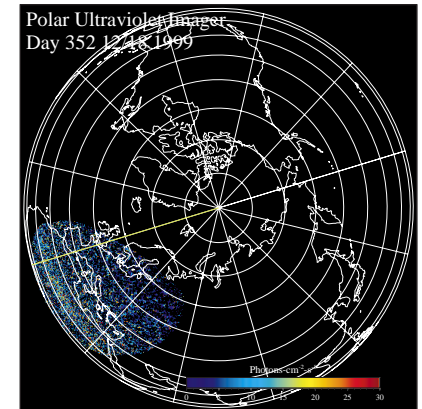
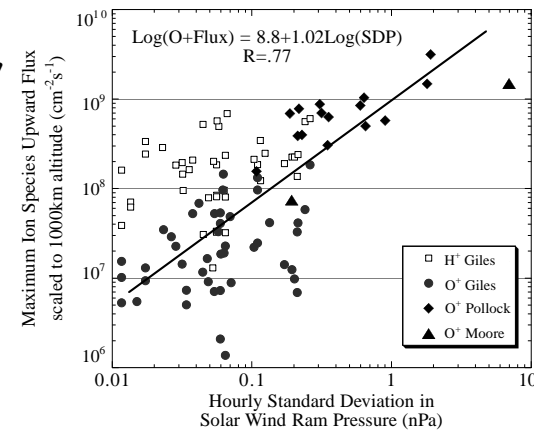
Polar substorm onsets in 1999–2000



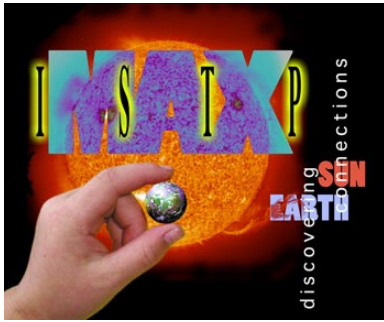


What we will learn that is new:

- How and when is auroral zone energy transmitted to low altitudes?
- Under what conditions does the ionosphere dominate the solar wind as a magnetosphere plasma source?
- What is the spatial and temporal coherence of ion outflow?
- How much oxygen escapes from the magnetosphere? How much is lost to the upstream region?
- How does atmospheric composition vary as a result of solar UV flux variation?

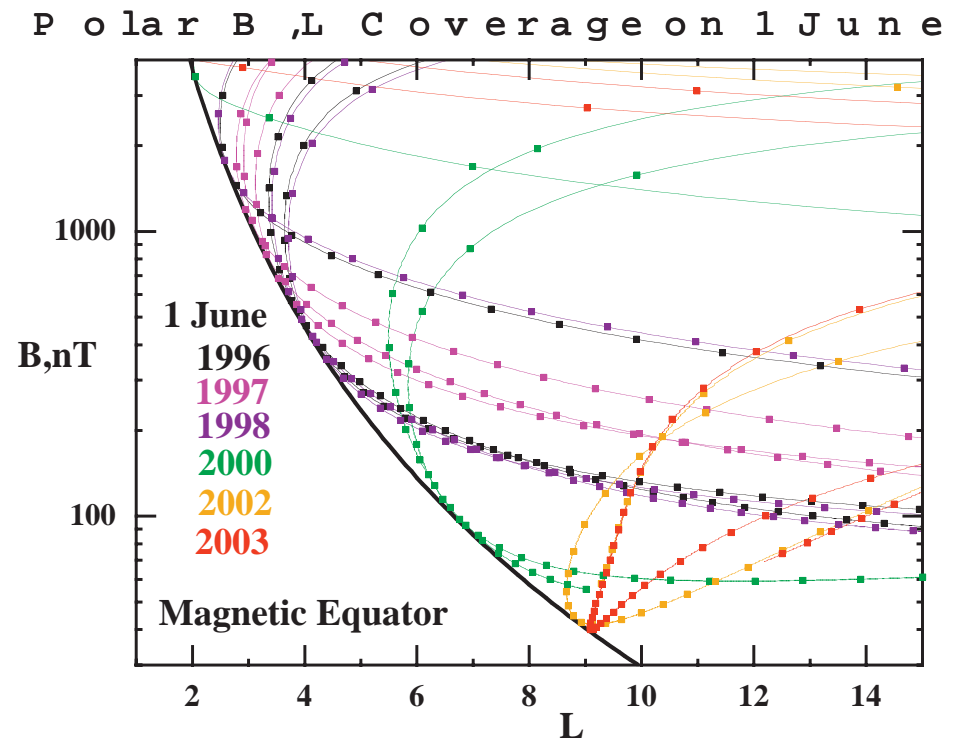


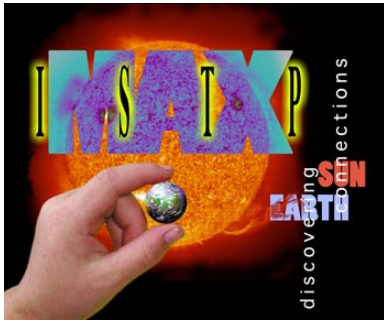
Oxygen Depletion Event



What we will learn that is new:

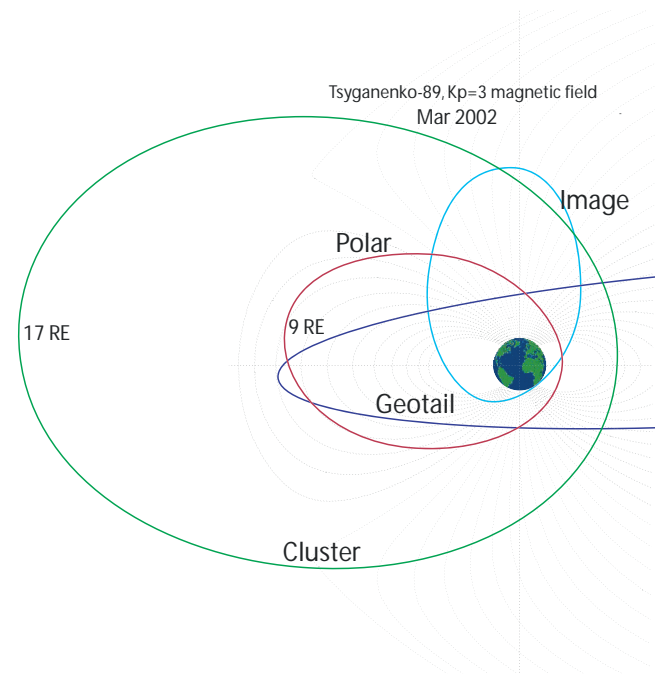
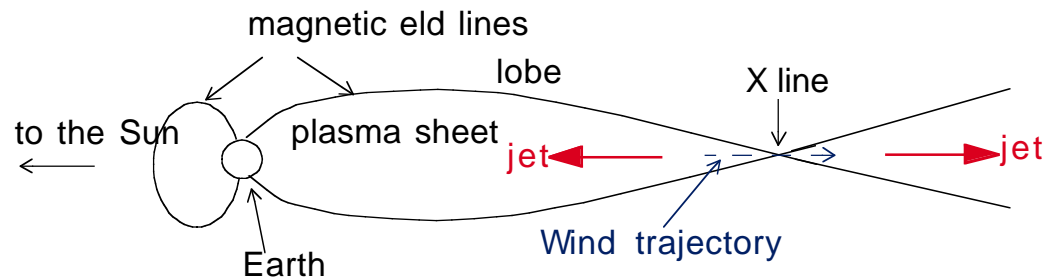
- What is the relative importance of the internal and external sources to magnetospheric energetic particle populations?
- What is the cause and effect of solitary wave structures on auroral particle acceleration?

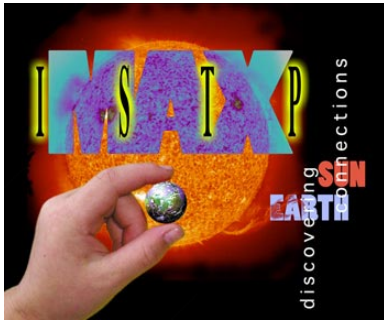




What we will learn that is new:

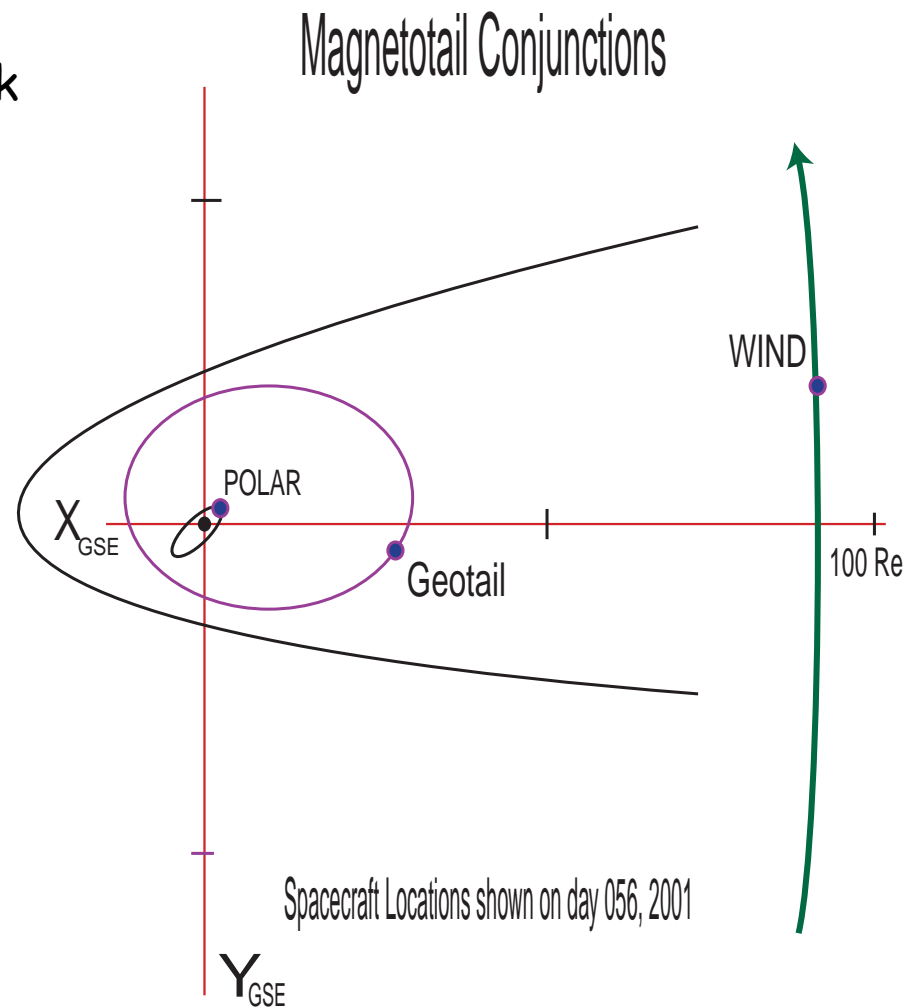
- What role does turbulence play at the boundary layers between solar and magnetospheric plasmas?
- What are the important processes? Sub-solar versus high latitude merging? Component versus antiparallel merging? Merging versus current disruption?

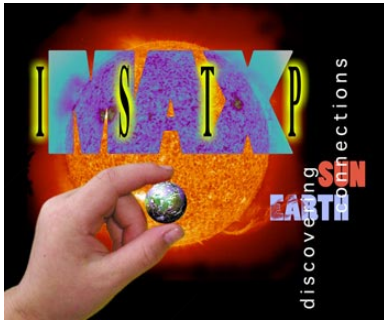




What we will learn that is new:

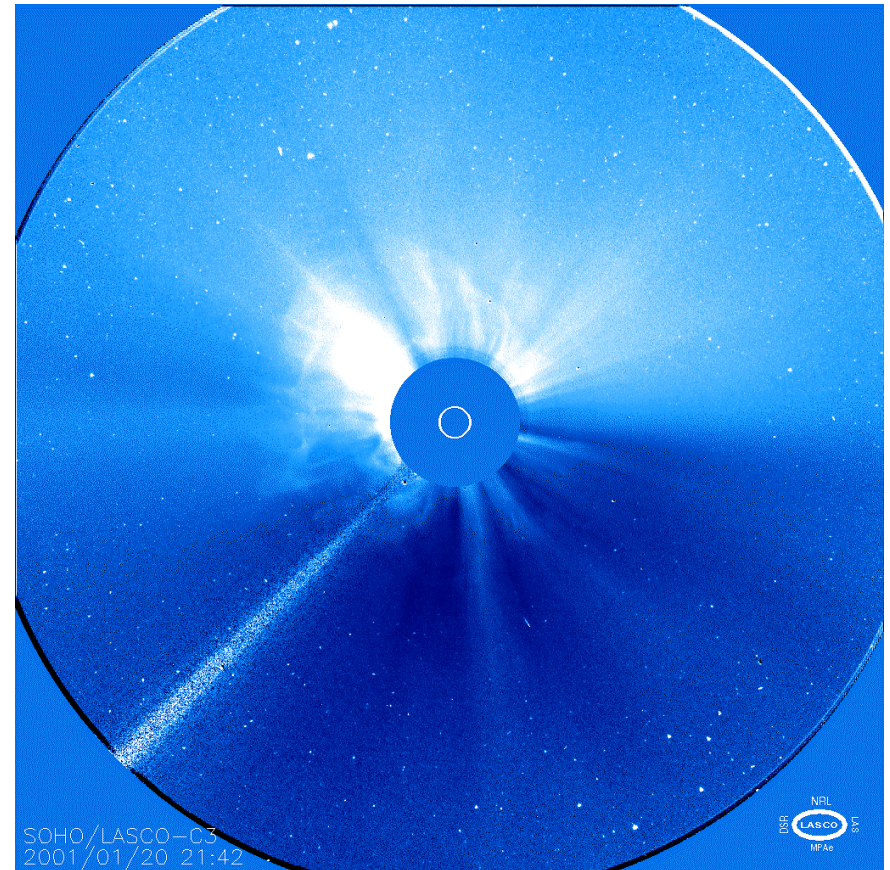
- Does the magnetotail begin to break up within 400 R_e downstream?



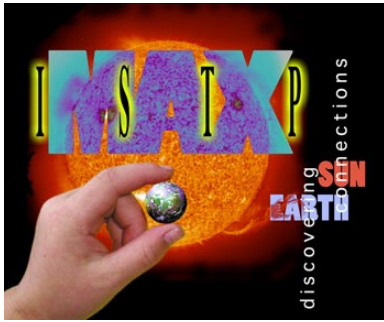


What we will learn that is new:

- What is the mesoscale topology of solar wind structures observed at 1 AU?
- How do interplanetary structures seen at 1 AU relate to solar impulsive events and their geoeffectiveness?
- Are there distinct classes of CMEs and what are the geoeffective consequences?



Jan 20, 2001: simultaneous observations by SOHO/LASCO and WIND/Waves at radio wavelengths show collision of pair of CMEs in the outer corona.



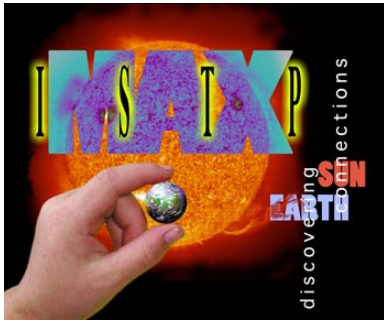
What we will learn that is new:

- What is the mechanism that accounts for solar energetic particle acceleration?
- Where do Gamma Ray Bursts originate and why are there two distinct classes of bursts?



SN 1998bw in Spiral Galaxy ESO184-G82

Gamma-ray burst supernova source SN199bw. The KONUS gamma-ray burst instrument on WIND, along with Ulysses and NEAR, provide gamma-ray burst source localizations.



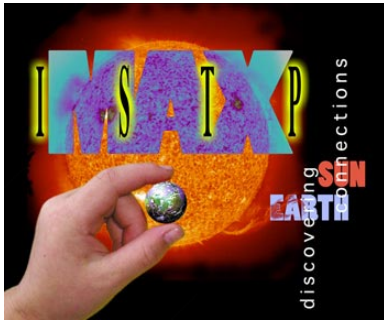
Status of the assets: spacecraft

Fields and
waves

Particles

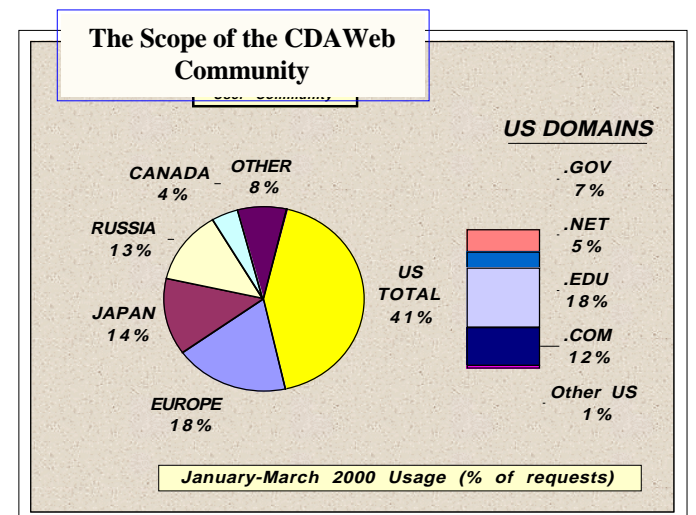
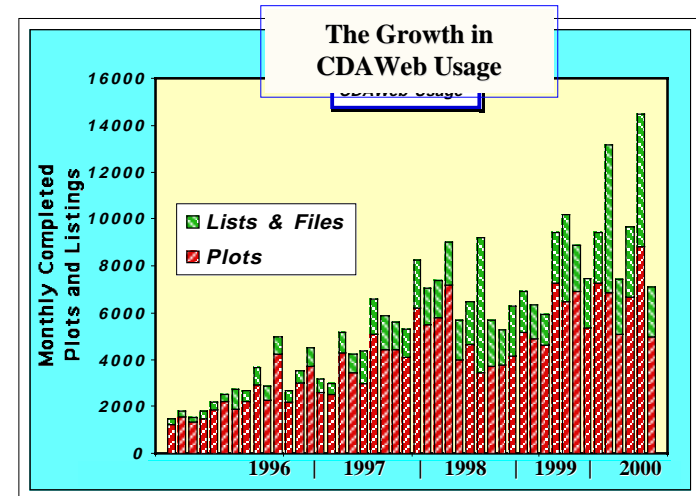
Imaging

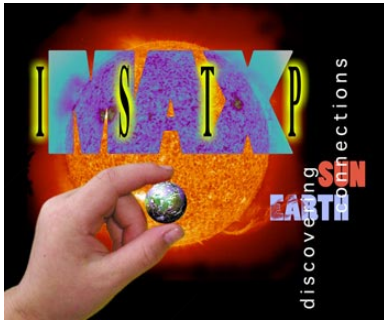
POLAR	WIND	GEOTAIL
MFE	MFI	MGF
EFI		EFD
PWI	Waves	PWI
CAMMICE	EPACT	HEP
CEPPAD	SMS	EPIC
HYDRA	3DP	LEP
TIMAS	SWE	CPI
TIDE		
UVI	KONUS	
PIXIE	TGRS	
VIS		



Status of the assets: data system

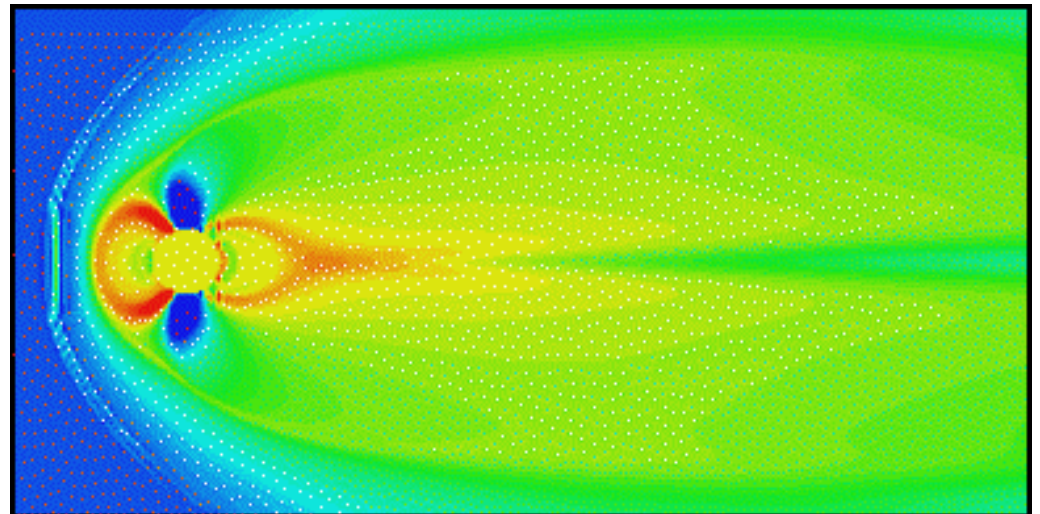
- CDHF - completely functional
- SPOF/EOF - completely functional
- Data Distribution - all level zero from WIND/POLAR/Geotail/SOHO/IMP 8
- CDAWeb - >0.3 Terabytes of Key Parameters
- Unique joining of data from current missions
 - NASA: ACE, FAST, IMAGE, IMP-8, Polar, SAMPEX, Wind
 - Other US: GOES, LANL
 - International: , Geotail, SOHO, Ulysses, Interball, Cluster
- International community of users
 - Service mirrored in Europe and Japan as part of NASA's support for the IACG

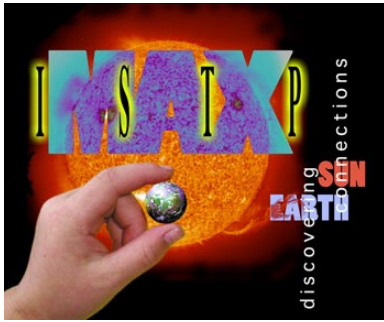




Status of the assets: Theory & modeling

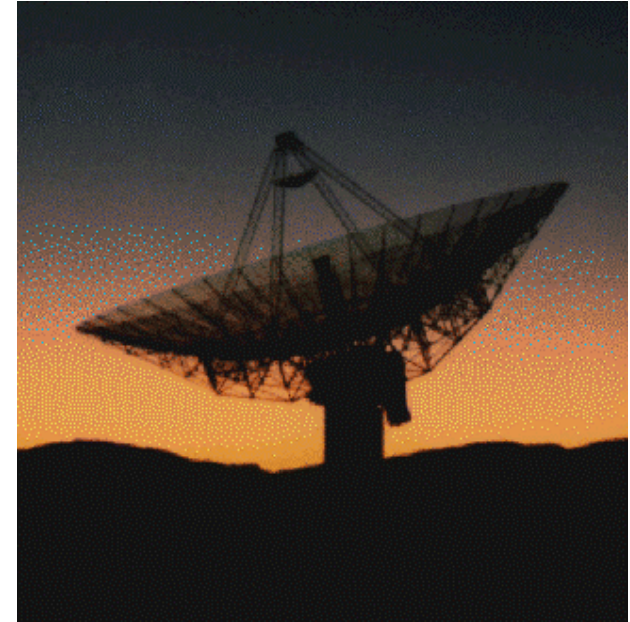
- Global magnetohydrodynamic simulations of the magnetosphere have been very successfully implemented by UCLA, UMD, and Dartmouth to provide a global framework for the ISTP observations from widely separated spacecraft
- Simulations of the aurora, the formation of new radiation belts, and global ionospheric convection patterns have also served to provide closure between spacecraft and ground-based observations and theory
- Issue: although capital has been invested in the simulation codes, present funding is not sufficient to provide the staffing to run these simulations in support of experimental observations

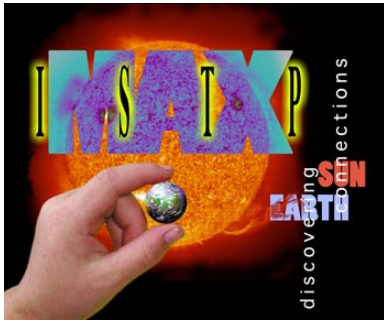




Status of the assets: Ground based

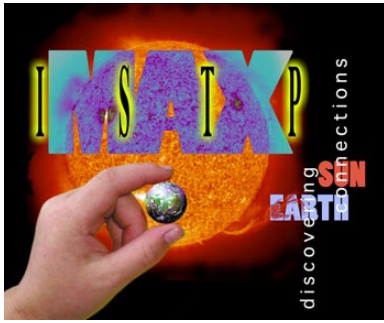
- Ground-based observatories have provided observational data for the final link in the sun-earth connections: energy deposition in the atmosphere and ionosphere. Examples include global convection patterns and detailed studies of processes underlying auroral dynamics.
- Large observation networks such as Superdarn were the direct result of NSF/NASA collaborations
- Issue: Some needed assets such as Superdarn are aging due to extreme environments. Will future NSF/NASA collaborations be possible to preserve these capabilities for ISTP and future missions?



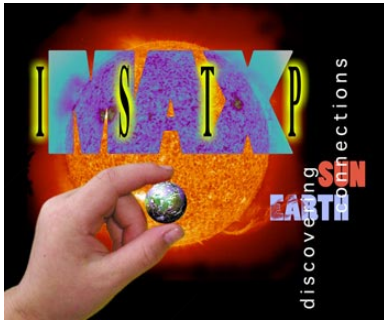


ISTP as a distributed observatory: Fresh Perspectives on the Complexities of Geospace Dynamics

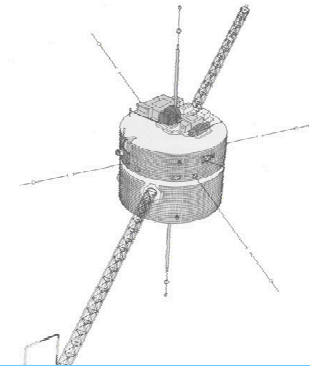
- Well-defined, focused science objectives directly contribute to our understanding of the Sun-Earth Connection.
- The ISTP “event driven” paradigm has expanded allowing more and more studies to be successfully defined and carried out with new and calibrated databases.
- The unique “end-to-end” diagnostic capability of ISTP has been thoroughly demonstrated: CME's, Solar Wind disappearances, SEP's, etc.



Backup slides



Comparison of the particle instruments on Polar



TIDE: 2D 0-500eV ions

TIMAS: 3D 300 eV/q - 32 keV/q ions

HYDRA – 3D 2-35 keV/q protons

CAMMICE: 6 keV/q - 60 MeV ion composition

CEPPAD – 3D 20 keV/q - 1 MeV protons

CEPPAD: >10 MeV protons

TIMAS MEASUREMENTS:

- Energy Range: 15 eV/e - 32 keV/q
- Mass Range: 1 - 32 AMU/q
- Angular Resolution: 11.25 x 11.25 deg.
- Time Resolution: 2-D: 0.375 sec / 3-D: 3 sec

POLAR carries the full range of instrumentation necessary to resolve details of the field and particle interactions leading to particle acceleration throughout the inner magnetosphere - TIMAS is an important part of that instrument complement.



Growth in the Multi-Mission SEC Database

